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(पहला पुनरीक्षण)

Indian Standard

SEALING TEST FOR PRESSURIZED WAVEGUIDE TUBING AND ASSEMBLIES

(*First Revision*)

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BUREAU OF INDIAN STANDARDS
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NEW DELHI 110002

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Microwave Components and Accessories Sectional Committee, LTD 19

NATIONAL FOREWORD

This Indian Standard which is identical with IEC Pub 261 (1989) 'Sealing test for pressurized waveguide tubing and assemblies', issued by the International Electrotechnical Commission (IEC), was adopted by the Bureau of Indian Standards on the recommendation of the Microwave Components and Accessories Sectional Committee (LTD 19) and approval of the Electronics and Telecommunication Division Council.

Wherever the words 'International Standard' appear referring to this standard, they should be read as 'Indian Standard'.

In this adopted standard, reference appears to certain International Standards for which Indian Standards also exist. The corresponding Indian Standards which are to be substituted in their place are listed below along with their degree of equivalence for the editions indicated:

International Standard	*Corresponding Indian Standard*	*Degree of Equivalence*
IEC Pub 68-1 (1988) Environmental testing Part 1 : General and guidance	IS 9000 (Part 1) : 1988 Basic environmental testing procedures for electronic and electrical items: Part 1 General (*first revision*)	Technically equivalent
	IS 9001 (Part 1) : 1984 Guidance for environmental testing: Part 1 General	Technically equivalent
IEC Pub 68-2-17 (1978) Test Q : Sealing	IS 9000 (Part 15/Sec 1 to 9) : 1982 Basic environmental testing procedures for electronic and electrical items: Part 15 Sealing test	Technically equivalent

Only the English language text in the International Standard has been retained while adopting it in this Indian Standard.

Indian Standard

SEALING TEST FOR PRESSURIZED WAVEGUIDE TUBING AND ASSEMBLIES

(First Revision)

1. Scope

This standard specifies uniform measuring methods for sealing tests for pressurized waveguide components and assemblies. These measuring methods are carried out with regard to quantity and quality.

2. Unit of pressure

The following SI unit of pressure is used in this standard: pascal (Pa).

Notes 1. – 1 bar = 10^5 Pa.

2. – For ease in mathematical calculations it is recommended that the SI unit kilopascal (kPa) be used.

3. – [1 psi lbf/in^2] = 6.895 × 10^3 Pa.

3. Test method A: Pressure drop during elapsed time (quantity test)

The leak rate and the rate of pressure loss from a sealed assembly are determined by measuring the change in the internal pressure during a test time interval.

Cautionary note. – Safety precautions shall be taken when using test methods that require a positive pressure for testing components.

3.1 *Definitions of terms and symbols*

Leak rate

The quantity of a dry gas at a given temperature that flows through a leak per unit of time and for a known difference of pressure across the leak (see IEC Publication 68-2-17).

Unit

The basic SI unit for leak rate is "pascal cubic metre per second (Pa · m^3/s)". The derived unit "Pa · cm^3/s" is used in this standard:

$$\begin{aligned} 1 \text{ Pa} \times \text{m}^3/\text{s} &= 10^6 \text{ Pa} \times \text{cm}^3/\text{s} \\ &= 10 \text{ bar} \times \text{cm}^3/\text{s}. \end{aligned}$$

Note. – During the test period, the pressure inside the component may decrease and the ambient pressure outside the waveguide may fluctuate. In all of these tests, any error due to variations in the pressure differential arising from the above effects during the testing period has been neglected.

Gauge pressure

The pressure as shown by a pressure gauge, that is the amount by which the pressure exceeds atmospheric pressure.

Standard atmospheric conditions

A temperature of 293 K (that corresponds to 20 °C), and a pressure of 101.3 kPa. (These conditions are described in IEC Publication 68-1.)

Symbols

P_0 = standard pressure (101.3 kPa)
P_1 = initial atmospheric pressure
P_2 = final atmospheric pressure
P_{e1} = initial gauge pressure
P_{e2} = final gauge pressure
$P_{1.0}$ = initial absolute pressure within the assembly, corrected to standard temperature of 293 K
$P_{2.0}$ = final absolute pressure within the assembly, corrected to standard temperature of 293 K
$P_{1.2}$ = pressure drop during test time interval, corrected to standard temperature of 293 K
T_1 = initial waveguide gas temperature (K)
T_2 = final waveguide gas temperature (K)
V = combined volume of the assembly and the pressure-measuring apparatus
LR_c = leak rate, corrected to standard temperature
t = testing time interval.

3.2 *Test procedure*

a) Pressurize the assembly with air to the specified gauge pressure and disconnect the source of air.

b) Allow sufficient time for the internal pressure to become stable and then record the gauge pressure P_{e1}, the ambient pressure P_1 and the waveguide gas temperature T_1.

c) At the end of the test time interval, record the gauge pressure P_{e2}, the ambient pressure P_2 and the waveguide gas temperature T_2.

d) Convert P_{e1} and P_{e2} to the corresponding absolute values according to the formulae:

$$P_{1.0} = (P_1 + P_{e1}) \frac{293}{T_1}$$

and

$$P_{2.0} = (P_2 + P_{e2}) \frac{293}{T_2}$$

e) Calculate the temperature-corrected pressure drop $P_{1.2}$ during the test time interval from the relation:

$$P_{1.2} = P_{1.0} - P_{2.0}$$

f) To convert pressure loss to volume of leak, use the formula:

$$LR_c = \frac{P_{1.2} \times V}{t} \quad (10^5 \text{ Pa} \times \text{dm}^3 \times \text{h}^{-1} \text{ or } 10^5 \text{ Pa} \times \text{cm}^3 \times \text{s}^{-1})$$

Example: The combined volume of a waveguide assembly and its pressure-measuring apparatus is 8.195 dm³. It is pressurized with air and the initial gauge reading is 3.44 10⁵ Pa. This reading is taken when the atmospheric pressure is 93 kPa and the temperature of the waveguide is 293 K. After 24 h, the gauge pressure has dropped to 3.29 10⁵ Pa, the atmospheric pressure is 96 kPa and the temperature of the waveguide is 298 K. Calculate the leak rate in 10⁵ Pa × dm³/h.

$$P_{1.0} = \frac{(3.44 \times 10^5 \text{ Pa} + 0.93 \times 10^5 \text{ Pa}) \times 293 \text{ K}}{293 \text{ K}} = 4.37 \times 10^5 \text{ Pa}$$

$$P_{2.0} = \frac{(3.29 \times 10^5 \text{ Pa} + 0.96 \times 10^5 \text{ Pa}) \times 293 \text{ K}}{298 \text{ K}} = 4.18 \times 10^5 \text{ Pa}$$

$$P_{1.2} = 4.37 \times 10^5 \text{ Pa} - 4.18 \times 10^5 \text{ Pa} = 0.19 \times 10^5 \text{ Pa}$$

$$LR_c = \frac{8.195 \text{ dm}^3 \times 0.19 \times 10^5 \text{ Pa}}{24 \text{ h}} = 6.49 \times 10^{-2} \times 10^5 \text{ Pa} \times \text{dm}^3/\text{h}$$

3.3 *Preferred test conditions*

Unless otherwise specified:

- the test gauge pressure P_{e1} shall be 10^5 Pa;
- the test time interval shall be 24 h;
- the pressure drop shall not exceed 5% of the test gauge pressure P_{e1} within the waveguide;
- the maximum permissible ratio of the measurement apparatus volume shall be 0.1 to that of the waveguide assembly volume;
- the maximum permissible variation of the ambient temperature shall be ±5 K.

3.4 *Summary of details which may need to be specified in the relevant specification*

Where this test is included in the relevant specification, the following details shall be specified, if they differ from Sub-clause 3.3:

- desired test gauge pressure P_{e1} (Pa);
- desired test time interval, in hours;
- maximum permissible pressure drop during the test, respectively maximum permissible leak rate;
- maximum permissible ratio of the volume of the measurement apparatus to that of the waveguide assembly volume;
- maximum permissible variation of the ambient temperature during the test (this temperature variation limitation need not apply to tests made under field conditions).

4. Test method B: Leak rate

This test measures the leak rate of pressurized waveguide tubing and assemblies.

4.1 *Definition, units of terms and symbols*

Standard atmospheric conditions

A temperature of 20 °C (293 K) and a pressure of:

$$1.013 \times 10^5 \text{ Pa} = 1 \text{ atmosphere} = [14.696 \text{ lbf/in}^2]$$

Pressure

Pascals (Pa).

Leak Rate (LR_c)

The volume of air corrected to standard atmospheric conditions, which leaks per unit of time from a waveguide assembly at constant pressure.

Unit is: Pa × m^3/s.

Symbols

P_s = standard atmospheric pressure – 1 atmosphere: 1.013×10^5 Pa
P_t = test pressure per specification (Absolute pressure) (Pa)

4.2 *Test apparatus*

The test apparatus is shown in Figure 1.

4.3 *Test procedure*

a) Switch test purge valve B to purge position.

b) Switch pressure range valve A to desired pressure range (high-low).

c) Adjust regulator C or D to specified pressure.

d) Connect test unit.

e) Switch test/purge valve B to test position.

f) Allow system to stabilize.

g) Note flowmeter G reading. This is the leak rate of the waveguide assembly at test pressure.

h) Switch test/purge valve B to purge position.

i) Correct the leak rate at the test pressure to the corresponding value at standard atmospheric pressure according to the formula:

$$LR_c = P_t \times \text{flowmeter reading}$$

To measure the leak rate of the test apparatus itself, substitute a blank flange for the assembly under test and continue from Sub-clause 4.3.

Note. — Once the test pressure has been established in accordance with the specification, all assemblies tested in accordance with the same specification and pressure need only comply with Sub-clauses 4.4 and 4.5. Pressure drop at flowmeter is neglected and for a more precise measurement, insert a pressure gauge behind the flowmeter.

4.4 *Summary of details which may need to be specified in the relevant specification*

When this test is included in the relevant specification, the following details shall be specified:

- desired test pressure;
- maximum permissible leak rate;
- test time duration.

4.5 *Preferred test conditions*

- Unless otherwise specified, the maximum permissible temperature variation shall be ±5 K;
- the test time duration is 300 s;
- standard atmospheric conditions.

5. Test method C: Bubble test (quality test)

Since leaks cannot be located using test method A or B, the bubble test is employed to locate the origin of the leaks.

5.1 *Test procedure*

a) It is recommended to use soft water for the test bath. Its temperature shall not vary by more than ±2 K from the ambient temperature.

b) The assembly shall be set to the gauge test pressure as required, taking into account the pressure variation between the interior and exterior of the assembly at the test depth. The interior gauge test pressure shall be equal to the sum of the gauge pressure and the hydraulic pressure (1 mbar per cm test depth).

c) The pressurized assembly shall be immersed in the test bath at the appropriate test depth. The air bubbles on the surface of the assembly shall be removed by means of a brush.

d) Possible leaks in the test assembly can be detected by the bubbles that emerge from it. The quantity of air that escapes from a leak in the assembly shall be measured by means of a suitable collecting device (see IEC Publication 68-2-17, Test Qa).

e) After removal of the test assembly from the bath, it shall be properly dried. The internal test pressure shall then be lowered to atmospheric pressure.

5.2 *Preferred test conditions*

Unless otherwise specified:

— the test gauge pressure shall be 10^5 Pa;
— test time interval shall be 5 min;
— there shall be no bubbles during the test.

5.3 *Summary of details which may need to be specified in the relevant specification*

When this test is included in the relevant specification, the following details shall be specified if they differ from those in 5.2:

— test liquid, unless soft water is used;
— test time interval;
— test temperature, if other than ambient temperature;
— test gauge pressure;
— maximum permissible volume of leakage;
— if applicable, information about drying procedure.

6. Test method D: Halogen leakage test (quality test)

When test methods A, B or C are not practical, the halogen leakage test is recommended. It is most suitable for the inspection of already installed line-systems. This test method does not enable, however, precise measuring results to be obtained on the leak rate, because such factors as leakage hole configuration (round or flat), concentration variations through air currents, and the shape of the test assembly have their effects.

The halogen gas detector is an applicable device for the halogen test method. For this purpose, the waveguide assembly must be pressurized with halogen such as refrigerant gas, or a mixture of halogen gas and air.

The leak is located by moving the detector probe along the surface of the assembly. Any escaping gas will be indicated by the control unit.

Halogen gas detectors have a long response time, so that locating a leak may be difficult. The usefulness of halogen gas detectors can be seriously impaired if the environmental air is polluted by, for example, smoke.

Escaping halogen test gas can also contaminate the atmosphere of the test room and thus affect the test results. Therefore, the test room should always be aired and the filling and emptying of the assembly should be done in a separate room.

The sensitivity of these instruments is proportional to the concentration of the refrigerant gas used to pressurize the waveguide. In general, the indication accuracy is dependent upon the detector and the type of leakage.

If the halogen leakage test is ordered, the necessary details shall be agreed upon beforehand, and the manufacturer's instructions should be taken into account.

7. Test method E: Helium leakage test (quantity and quality test)

This test method can determine very small leak rates. Since this is always carried out under vacuum conditions, the test assembly must be capable of withstanding the mechanical stress, and have a leak rate LR_c of no more than:

$$1 \text{ Pa} \times \text{cm}^3/\text{s}$$

If a higher leak rate is detected, test methods A to C shall be applied.

Test Method 1

A suitable test method is described in Test Qk of IEC Publication 68-2-17. Components, which must meet extremely high leak tightness requirements, for operation in vacuum tubes and line assemblies, can be tested with a helium semi-circular-focusing magnetic spectrometer. For this purpose, the test assembly, which is under helium gauge pressure, shall be connected to a test equipment in a separate test chamber. The chamber shall be evacuated and, by means of the above spectrometer, the helium escaping from the test assembly should be measured.

This test method permits the determination of leak rates between:

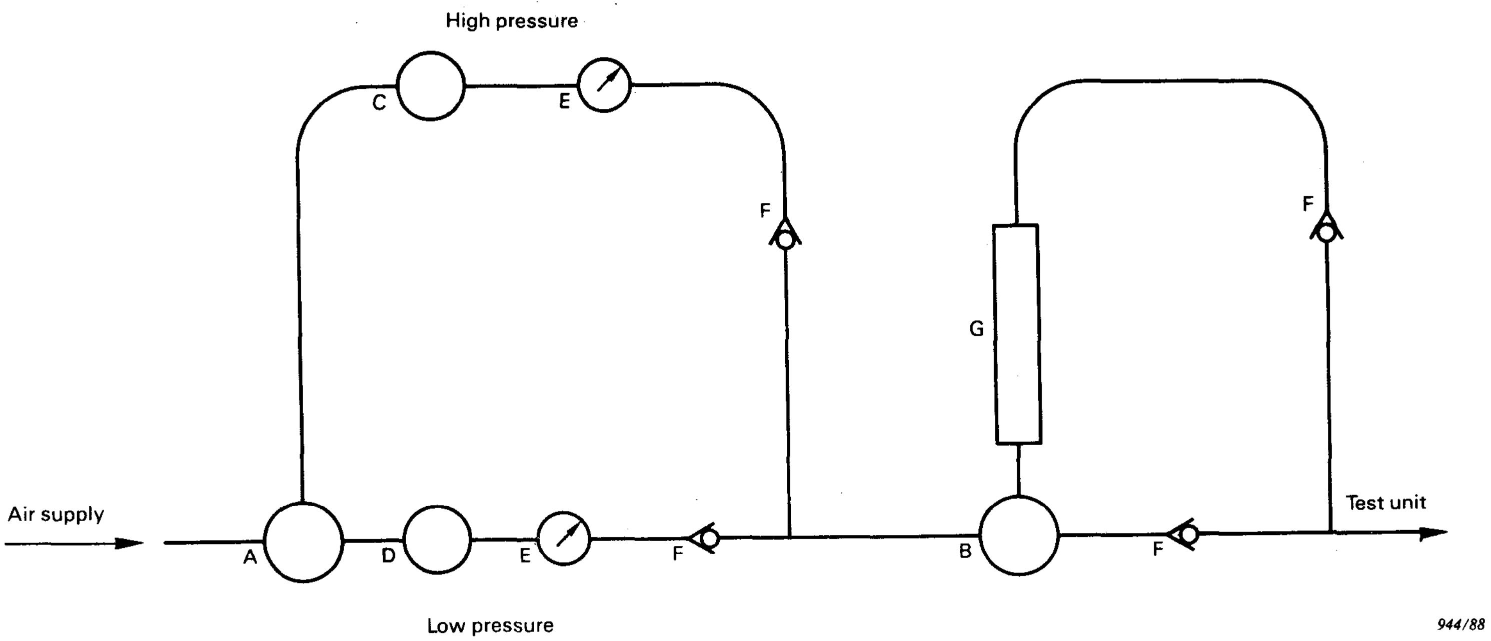
$$1 \text{ and } 10^{-4} \text{ Pa} \times \text{cm}^3/\text{s}$$

This test method requires a large installation and is especially suitable for assemblies of small volumes.

Test Method 2

The leak tight test assembly shall be connected to the test equipment and evacuated. The exterior of the assembly, respectively, the critical points shall be sprayed with helium which, in case of any leaks, will penetrate into the assembly and will be so indicated on the spectrometer.

If, instead of being sprayed with helium, the test assembly is placed in a container with helium pressure, the leak rate can also be determined qualitatively by comparison with a calibrated standard leak.



A = pressure range valve — High/Low
B = test/purge valve
C = pressure regulator (high range)
D = pressure regulator (low-range)
E = pressure gauges
F = check valves
G = flowmeter

FIG. 1. — Leak rate test.

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